

## REMARKS

This paper is being submitted in response to the Office Action mailed March 13, 2003, for the above-referenced application. In this response, claims 7 and 23 have been amended to clarify that which Applicant considers to be the invention. Further, Applicants have added new claim 30. Applicants respectfully submit that the amendments to the claims and the new claims are supported by the originally-filed specification.

The rejection of claims 7 and 23 under 35 U.S.C. 112, second paragraph, as being indefinite has been addressed by the amendments to the claim contained herein according to the guidelines set forth in the Office Action. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 1, 8-10, 18, 19, 25, 26 and 28 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,409,784 to Bromberg et al. (hereinafter "Bromberg") is hereby traversed and reconsideration is respectfully requested.

Applicants' independent claim 1 recites a plasmatron-catalyst apparatus for generating hydrogen-rich gas including a plasmatron. At least one catalyst receives an output from the plasmatron to produce hydrogen-rich gas. The at least one catalyst is positioned downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron. Claims 2-24 depend directly or indirectly on claim 1.

Applicants' independent claim 25 recites a plasmatron-catalyst apparatus for generating

hydrogen-rich gas including a plasmatron. A catalytic converter containing at least one catalyst receives an output from the plasmatron to produce a hydrogen-rich gas. The at least one catalyst in the catalytic converter is located at a position downstream from the plasmatron and is activated by hydrogen and radicals produced in the output of the plasmatron. Claims 26-29 depend directly or indirectly on claim 25.

Applicants' independent claims all recite the feature of *at least one catalyst that is positioned downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron*. Applicants disclose a synergism between a plasmatron and a catalyst positioned downstream from the plasmatron. Radicals produced in the plasma can travel to the location of the catalyst and *activate the catalyst* in order to generate very active catalysis. The catalyst must be close to the plasmatron in order to effectively use the radicals that are generated because the radicals have very short lifetimes. (See page 7, lines 1-14).

Applicant's respectfully submit that Bromberg does not teach or suggest *a catalyst located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron*. Bromberg discloses a hydrogen separator membrane, but does not teach that the membrane must be positioned so as to be activated by the radicals produced by the plasmatron. Arguably, Bromberg's hydrogen separator membrane does not require activation by radicals contained within the plasmatron output stream in order to perform its hydrogen separator function. As such, Bromberg does not disclose a particular downstream position of the hydrogen separator membrane.

Applicants, on the other hand, recite a position of at least one catalyst that is positioned downstream in order to be activated by short-lived radicals contained within the output stream of the plasmatron. The activation of the catalyst generates very active catalysis of the system that can be used to (1) increase the throughput through the catalyst; (2) decrease the amount of catalyst required, for a given flow rate; and (3) accomplish more than one function of the catalyst. (See page 7, lines 6-8). Applicants respectfully submit that Bromberg does not teach at least the above-noted feature of Applicants' claimed invention. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claim 20 under 35 U.S.C 103(a) as being unpatentable over Bromberg in view of Published PCT Application No. WO 96/39576 (hereinafter "WO 96/39576") is hereby traversed and reconsideration is respectfully requested.

Claim 20 depends from independent claim 1, the features of which are discussed above.

The WO 96/39576 reference discloses an engine system with exhaust apparatus that includes a hydrogen oxidation catalyst and a CO oxidation catalyst in order to reduce the hydrocarbon light-off time.

Applicant's respectfully submit that WO 96/39576 fails to overcome the above noted deficiencies of Bromberg with respect to Applicants' independent claims. Specifically, Applicants respectfully submit that neither Bromberg nor WO 96/39576, taken alone or in combination, teach or suggest *a catalyst located at a position downstream from the plasmatron*

*so as to be activated by hydrogen and radicals produced by the plasmatron*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 24 and 29 under 35 U.S.C. 103(a) as being unpatentable over Bromberg is hereby traversed and reconsideration is respectfully requested.

Claims 24 and 29 depend from independent claims 1 and 25, respectively, the features of which are described above.

Applicants respectfully submit that Bromberg does not teach or suggest *a catalyst located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron*. Further, concerning claims 24 and 29 specifically, Applicants' respectfully submit that Bromberg does not teach or suggest that the position of the at least one catalyst is within 1 to 10 cm downstream from the plasmatron. Applicants have found that for velocities of 10-100 m/s, the catalyst should be located within 1 cm to 10 cm downstream from the plasma source in order to effectively use the radicals that are generated. (See page 7, lines 11-14). Bromberg does not disclose any desired positioning of the hydrogen separator membrane as compared with a catalyst positioned so as to be activated by hydrogen and radicals produced by the plasmatron as claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 2, 3, 4, 5, 6, 7 and 15 under 35 U.S.C. 103(a) as being

unpatentable over Bromberg in view of U.S. Patent No. 5,852,927 to Cohn et al. (hereinafter "Cohn") is hereby traversed and reconsideration is respectfully requested.

Claims 2, 3, 4, 5, 6, 7 and 15 depend from independent claim 1, the features of which are described above.

The Cohn reference discloses an integrated plasmatron-turbine system and is cited by the Office Action as disclosing that plasmatrons of a conventional design have an air input stream.

Applicants respectfully submit that Cohn fails to overcome the above noted deficiencies of Bromberg with respect to Applicant's independent claims. Specifically, neither Cohn nor Bromberg, taken alone or in combination, teach or suggest *a catalyst located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 16 and 17 under 35 U.S.C. 103(a) as being unpatentable over Bromberg in view of Cohn and further in view of U.S. Patent No. 5,425,332 to Rabinovich et al. (hereinafter "Rabinovich") is hereby traversed and reconsideration is respectfully requested.

Claims 16 and 17 depend from independent claim 1, the features of which are described above.

The Rabinovich reference discloses an internal combustion engine connected to receive hydrogen-rich gas from a plasmatron and is cited by the Office Action as disclosing that waste water is recycled back to the plasmatron and that a diesel engine can be utilized with a plasmatron.

Applicants respectfully submit that Rabinovich fails to overcome the above noted deficiencies of Bromberg and Cohn with respect to Applicant's independent claims. Specifically, neither Bromberg, Cohn nor Rabinovich, taken alone or in any combination, teach or suggest *a catalyst located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 11, 12, 14 and 21 under 35 U.S.C. 103(a) as being unpatentable over Bromberg in view of U.S. Patent No. 6,245,303 to Bentley et al. (hereinafter "Bentley") and further in view of U.S. Patent No. 5,567,398 to Ruhl et al. (hereinafter "Ruhl") is hereby traversed and reconsideration is respectfully requested.

Claims 11, 12, 14 and 21 depend from independent claim 1, the features of which are described above.

The Bentley reference discloses a reactor for producing hydrogen from hydrocarbon fuels including a first zone, a second zone, a third zone, a fourth zone and a product gas collection space. The Office Action cites Bentley as disclosing the use of a partial oxidation process,

followed by steam reforming, and followed lastly by a shift reaction wherein each reaction uses a catalyst.

The Ruhl reference discloses a compact endothermic reaction apparatus and is cited by the Office Action as disclosing that excess water used in a water shift reaction will result in increased CO<sub>2</sub> and H<sub>2</sub> produced.

Applicants respectfully submit that Bentley and Ruhl fail to overcome the above noted deficiencies of Bromberg with respect to Applicant's independent claims. Specifically, neither Bromberg, Bentley nor Ruhl, taken alone or in any combination, teach or suggest *a catalyst located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 13 and 22 under 35 U.S.C. 103(a) as being unpatentable over Bromberg in view of Bentley and further in view of Ruhl and U.S. Patent No. 5,674,308 to Meissner et al. (hereinafter "Meissner") is hereby traversed and reconsideration is respectfully requested.

Claims 13 and 22 depend from independent claim 1, the features of which are described above.

The Meissner reference discloses a method and apparatus for producing direct reduced

iron from iron oxide fines and is cited by the Office Action as disclosing that steam reforming requires excess water to prevent carbon deposition on a reforming catalyst.

Applicants respectfully submit that Bentley and Ruhl fail to overcome the above noted deficiencies of Bromberg with respect to Applicant's independent claims. Specifically, neither Bromberg, Bentley nor Ruhl, taken alone or in any combination, teach or suggest *a catalyst located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.

The rejection of claims 23 and 27 under 35 U.S.C. 103(a) as being unpatentable over Bromberg in view of Rabinovich is hereby traversed and reconsideration is respectfully requested.

Claims 23 and 27 depend from independent claims 1 and 25, respectively, the features of which are described above.

Applicants respectfully submit that Rabinovich fail to overcome the above noted deficiencies of Bromberg with respect to Applicant's independent claims. Specifically, neither Bromberg nor Rabinovich taken alone or in any combination, teach or suggest *a catalyst located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron*, as is claimed by Applicants. Accordingly, Applicants respectfully request that this rejection be reconsidered and withdrawn.



Applicants have added new independent claim 30 and respectfully submit that this claim is allowable over the prior art of record. Applicants have found that for velocities of 10-100 m/s, the catalyst should be located within 1 cm to 10 cm downstream from the plasma source in order to effectively use the radicals that are generated. (See page 7, lines 11-14). Applicants respectfully submit that none of the prior art of record teaches or suggests at least this feature.

Based on the above, Applicants respectfully request that the Examiner reconsider and withdraw all outstanding objections and rejections. Favorable consideration and allowance are earnestly solicited. Should there be any questions after reviewing this paper, the Examiner is invited to contact the undersigned at 617-248-4792.

Please charge any fees that may be required and which have not been provided for in accompanying documents or credit any overpayments to our Deposit Account No. 03-1721.

Respectfully submitted,



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